CLAIM LISTINGS

Please amend claims 1, 3 and 8 thru 10, and add claims 26 thru 41, as follows.

Pursuant to 37 CFR §121(c), the claim listing, including the text of the claims, will serve to replace all prior versions of the claims, in the application.

1. (Currently Amended) [[An]] A method for compensating a carrier frequency offset in an orthogonal frequency division multiplexing by making an approximation [[method]] for a series expansion of an input function with a finite number of terms N to minimize an approximation error, comprising the steps of:

expanding the input function in Taylor series up to an (N-1)-th term to obtain a first expansion result;

expanding the input function in Taylor series up to an N-th term to obtain a second expansion result;

multiplying the first expansion result by a predetermined weight α to obtain a multiplication result;

combining the multiplication result and the second expansion result to obtain a combined result; and

dividing the combined result by $(\alpha + 1)$.

2. (Original) The method of claim 1, wherein α is greater than 0 and no greater than 1.

3. (Currently Amended) [[An]] A method for compensating a carrier frequency offset in an orthogonal frequency division multiplexing system, by making an approximation [[method]] for a series expansion of an input function with a finite number of terms N to minimize an approximation error, comprising the steps of:

expanding the input function in Taylor series up to an (N-1)-th term to obtain an expansion result;

multiplying an N-th term of the expansion result by a predetermined weight value to obtain a multiplication result; and

combining the expansion result and the multiplication result to obtain an approximation function f for the series expansion of the input function.

4. (Original) The method of claim 3, wherein the predetermined weight value is $\frac{(-1)^N}{(\alpha+1)}$, for $0<\alpha\leq 1$.

5. (Original) The method of claim 4, wherein a value α obtained for a corresponding respective N is selected so as to minimize a maximum of the approximation error.

6. (Original) The method of claim 4, wherein the value of α is obtained by:

(a) selecting a minimum input in a given input x area;

(b) calculating the approximation function f for the input with the finite number of terms N;

(c) obtaining and storing an error $|E_{N,x}|$ by subtracting the approximation function f from

a nominal function value of the input x;

(d) determining whether the input x has reached a maximum value in the given input x area;

(e) adding a predetermined increment ξ to the input x if the input x has not yet reached the maximum value, and repeating steps (b), (c) and (d);

(f) selecting a maximum error value among all the stored errors of $|E_{N,x}|$ for all inputs when x has reached a maximum value; and

(g) searching the value α to minimize the maximum error value, and storing the value α as the weight value for a corresponding N.

7. (Original) The method of claim 3, wherein the value of α is obtained by:

(a) selecting a minimum input in a given input x area;

(b) calculating the approximation function f for the input with the finite number of terms N;

(c) obtaining and storing an error $|E_{N,x}|$ by subtracting the approximation function f from a nominal function value of the input x;

(d) determining whether the input x has reached a maximum value in the given input x area;

(e) adding a predetermined increment ξ to the input x if the input x has not yet reached the maximum value, and repeating steps (b), (c) and (d);

(f) selecting a maximum error value among all the stored errors of $|E_{N,x}|$ for all inputs when x has reached a maximum value; and

(g) searching the value α to minimize the maximum error value, and storing the value α as the weight value for a corresponding N.

8. (Currently Amended) [[An]] A method for compensating a carrier frequency offset in an orthogonal frequency division multiplexing system, by making an approximation [[method]] for a series expansion of an input function with a finite number of terms N to minimize an approximation error, comprising the steps of:

dividing a whole input area into several predetermined sub-intervals:

expanding the input function in Taylor series up to an (N-1)-th term in each of the sub-intervals to obtain a series expansion for each sub-interval;

multiplying an N-th term of the series expansion of the input function with a predetermined first weight for inputs on a left side of a center for said each of the sub-intervals;

multiplying an N-th term of the series expansion with a predetermined second weight for inputs on a right side of the center for said each of the sub-intervals; and

combining the series expansion and the multiplied N-th term with the predetermined first and second weights to obtain an approximation of the input function in said each of the sub-intervals.

9. (Currently Amended) The method of claim 8, wherein the predetermined first and second weights on the left and right side, respectively, in said each ~~of the sub-intervals~~ sub-interval are selected to minimize a maximum error between the approximation of the input function with the finite number of terms N and a nominal value of the input function over all inputs in corresponding sub-intervals.

10. (Currently Amended) A method for compensating a carrier frequency offset in an orthogonal frequency division multiplexing (OFDM) system, comprising <u>the steps of</u>:

estimating the carrier frequency offset $\hat{\varepsilon}$ by using a series expansion of an arctangent function arctan(x);

using the estimated carrier frequency offset to obtain a phase rotation value for a first input sample of k=1, wherein $\sin(2\pi\hat{e})$ and $\cos(2\pi\hat{e})$ are series-expanded to minimize an approximation error;

using a phase rotation value for a previous input sample including k=1 to obtain a phase rotation value for a subsequent input sample; and

compensating the phase rotation values for all input samples.

11. (Original) The method of claim 10, wherein the estimated carrier frequency offset $\hat{\varepsilon}$ is represented by $\hat{\varepsilon} = \frac{1}{2\pi}\arctan\left\{\frac{\sum_{i=1}^{L}\mathrm{Im}(y(-i)y^{*}(L-i))}{\sum_{i=1}^{L}\mathrm{Re}(y(-i)y^{*}(L-i))}\right\}$, where Re and Im represent a real part and an imaginary part, respectively, of a complex number, y(i) represents an i-th received sample, L is a fast fourier transformation (FFT) size, and $\hat{\varepsilon}$ is an estimated and normalized carrier frequency offset of $\Delta\hat{f}T$.

12. (Original) The method of claim 11, wherein the phase rotation value for a k-th sample is calculated by:

$$For \quad k=1, \quad \cos(\Delta\hat{\omega}T_s)=\sum_{n=0}^{N}(-1)^n\frac{\Delta\hat{\omega}T_s^{\,2n}}{(2n)!}$$

$$\sin(\Delta\hat{\omega}T_s)=\sum_{n=0}^{N}(-1)^n\frac{\Delta\hat{\omega}T_s^{\,(2n+1)}}{(2n+1)!}$$

$$\begin{aligned}For \quad k\geq 2, \quad \cos(k\Delta\hat{\omega}T_s)&=\cos((k-1)\Delta\hat{\omega}T_s+\Delta\hat{\omega}T_s)\\&=\cos((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s)-\sin((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s)\\ \sin(k\Delta\hat{\omega}T_s)&=\sin((k-1)\Delta\hat{\omega}T_s+\Delta\hat{\omega}T_s)\\&=\sin((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s)+\cos((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s)\end{aligned}$$

13. (Original) The method of claim 10, wherein the phase rotation value for a k-th sample is calculated by:

$$For \quad k=1, \quad \cos(\Delta\hat{\omega}T_s)=\sum_{n=0}^{N}(-1)^n\frac{\Delta\hat{\omega}T_s^{\,2n}}{(2n)!}$$

$$\sin(\Delta\hat{\omega}T_s)=\sum_{n=0}^{N}(-1)^n\frac{\Delta\hat{\omega}T_s^{\,(2n+1)}}{(2n+1)!}$$

$$\begin{aligned}For \quad k\geq 2, \quad \cos(k\Delta\hat{\omega}T_s)&=\cos((k-1)\Delta\hat{\omega}T_s+\Delta\hat{\omega}T_s)\\&=\cos((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s)-\sin((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s)\\ \sin(k\Delta\hat{\omega}T_s)&=\sin((k-1)\Delta\hat{\omega}T_s+\Delta\hat{\omega}T_s)\\&=\sin((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s)+\cos((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s)\end{aligned}$$

14. (Original) An approximation system for a series expansion of an input function with a finite number of terms N to minimize an approximation error, comprising:

an operational processing unit which expands the input function in Taylor series up to an (N-1)-th term to obtain a first expansion result, expands the input function in Taylor series up to an N-th term to obtain a second expansion result, multiplies the first expansion result by a predetermined weight α to obtain a multiplication result, combines the multiplication result and the second expansion result to obtain a combined result, and divides the combined result by $(\alpha+1)$.

15. (Original) The system of claim 14, wherein α is greater than 0 and no greater than 1.

16. (Original) The system of claim 14, wherein α obtained for a corresponding respective N is selected so as to minimize a maximum approximation error.

17. (Original) An approximation system for a series expansion of an input function with a finite number of terms N to minimize an approximation error, comprising:

an operational processing unit which expands the input function in Taylor series up to an (N-1)-th term to obtain an expansion result, multiplies an N-th term of the expansion result by a predetermined weight value to obtain a multiplication result, and combines the expansion result and the multiplication result to obtain an approximation function f for the series expansion function.

18. (Original) The system of claim 17, wherein the predetermined weight value is $\frac{(-1)^N}{(\alpha+1)}$ for $0<\alpha\leq 1$.

19. (Original) The system of claim 18, wherein α obtained for corresponding respective N is selected to minimize a maximum approximation error.

20. (Original) The system of claim 19, wherein α is obtained by:

(a) selecting a minimum input in a given input x area;

(b) calculating the approximation function f for the input function with the finite number of terms N

(c) obtaining and storing an error $E_{N,x}$ by subtracting approximation function f from a nominal function value of the input x;

(d) determining whether the input x has reached a maximum value in the given input x area, adding a predetermined increment ξ to x when x has not yet reached the maximum value, and repeating steps (b), (c) and (d);

(e) selecting a maximum error value among all the stored errors $E_{N,x}$ for all inputs when x has reached a maximum value; and

(f) searching α to minimize the maximum error value, and storing α as the weight value for a corresponding N.

21. (Original) The system of claim 17, wherein α obtained for corresponding respective N is selected to minimize a maximum approximation error.

22. (Original) An orthogonal frequency division multiplexing (OFDM) system for compensating a carrier frequency offset, comprising:

an estimator for estimating the carrier frequency offset $\hat{e}$ by using a series expansion of a function arctan(x);

a first phase rotation calculator for using the estimated carrier frequency offset to obtain a phase rotation value for a first input sample of k=1, wherein $\sin(2\pi\hat{e})$ and $\cos(2\pi\hat{e})$ are series-expanded to minimize an approximation error;

a second phase rotation calculator for using a phase rotation value for a previous input sample including k=1 to obtain a phase rotation value for a subsequent input sample; and

a compensator for compensating the phase rotation values for all input samples.

23. (Original) The system of claim 22, wherein the estimated carrier frequency offset $\hat{e}$ is represented by $\hat{\varepsilon} = \dfrac{1}{2\pi}\arctan\left\{\dfrac{\left[\sum_{i=1}^{L}\mathrm{Im}(y(-i)y^{*}(L-i))\right]}{\left[\sum_{i=1}^{L}\mathrm{Re}(y(-i)y^{*}(L-i))\right]}\right\}$, where Re and Im represent a real part

and an imaginary part, respectively, of a complex number, y(i) represents an i-th received sample, L is a fast fourier transformation (FFT) size, and $\hat{e}$ is an estimated and normalized carrier frequency offset of $\Delta\hat{f}T$.

24. (Original) The method of claim 23, wherein the phase rotation value for a k-th sample is calculated by

25. (Original) The method of claim 22, wherein the phase rotation value for a k-th sample is calculated by

$$For \quad k=1, \quad \cos(\Delta\hat{\omega}T_s) = \sum_{n=0}^{N}(-1)^n \frac{\Delta\hat{\omega}T_s^{\,2n}}{(2n)!}$$

$$\sin(\Delta\hat{\omega}T_s) = \sum_{n=0}^{N}(-1)^n \frac{\Delta\hat{\omega}T_s^{\,(2n+1)}}{(2n+1)!}$$

$$\begin{aligned} For \quad k \geq 2, \quad \cos(k\Delta\hat{\omega}T_s) &= \cos((k-1)\Delta\hat{\omega}T_s + \Delta\hat{\omega}T_s) \\ &= \cos((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s) - \sin((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s) \\ \sin(k\Delta\hat{\omega}T_s) &= \sin((k-1)\Delta\hat{\omega}T_s + \Delta\hat{\omega}T_s) \\ &= \sin((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s) + \cos((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s) \end{aligned}$$

26. (New) The method of claim 1, further comprising the steps of:

using the approximation to obtain a phase rotation value for a first input sample of k=1,

wherein $\sin(2\pi\hat{e})$ and $\cos(2\pi\hat{e})$ are series-expanded to minimize the approximation error;

using a phase rotation value for a previous input sample including k=1 to obtain a phase rotation value for a subsequent input sample; and

compensating the phase rotation values for all input samples.

27. (New) The method of claim 26, wherein an estimated carrier frequency effect $\hat{e}$ is represented by $\hat{\varepsilon} = \frac{1}{2\pi}\arctan\left\{\frac{\sum_{i=1}^{L}\mathrm{Im}(y(-i)y^{*}(L-i))}{\sum_{i=1}^{L}\mathrm{Re}(y(-i)y^{*}(L-i))}\right\}$, where Re and Im represent a real part and an imaginary part, respectively, of a complex number, y(i) represents an i-th received sample, L is a fast fourier transformation (FFT) size, and $\hat{\varepsilon}$ is an estimated and normalized carrier frequency offset of $\Delta\hat{f}T$.

28. (New) The method of claim 27, wherein the phase rotation value for a k-th sample is calculated by:

$$For \quad k=1, \quad \cos(\Delta\hat{\omega}T_s)=\sum_{n=0}^{N}(-1)^n \frac{\Delta\hat{\omega}T_s^{\,2n}}{(2n)!}$$

$$\sin(\Delta\hat{\omega}T_s)=\sum_{n=0}^{N}(-1)^n \frac{\Delta\hat{\omega}T_s^{\,(2n+1)}}{(2n+1)!}$$

$$\begin{aligned} For \quad k\ge 2, \quad \cos(k\Delta\hat{\omega}T_s) &= \cos((k-1)\Delta\hat{\omega}T_s+\Delta\hat{\omega}T_s) \\ &= \cos((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s)-\sin((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s) \\ \sin(k\Delta\hat{\omega}T_s) &= \sin((k-1)\Delta\hat{\omega}T_s+\Delta\hat{\omega}T_s) \\ &= \sin((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s)+\cos((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s) \end{aligned}$$

29. (New) The method of claim 1, wherein the phase rotation value for a k-th sample is calculated by:

$$For \quad k=1, \quad \cos(\Delta\hat{\omega}T_s)=\sum_{n=0}^{N}(-1)^n \frac{\Delta\hat{\omega}T_s^{\,2n}}{(2n)!}$$

$$\sin(\Delta\hat{\omega}T_s)=\sum_{n=0}^{N}(-1)^n \frac{\Delta\hat{\omega}T_s^{\,(2n+1)}}{(2n+1)!}$$

$$\begin{aligned} For \quad k\ge 2, \quad \cos(k\Delta\hat{\omega}T_s) &= \cos((k-1)\Delta\hat{\omega}T_s+\Delta\hat{\omega}T_s) \\ &= \cos((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s)-\sin((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s) \\ \sin(k\Delta\hat{\omega}T_s) &= \sin((k-1)\Delta\hat{\omega}T_s+\Delta\hat{\omega}T_s) \\ &= \sin((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s)+\cos((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s) \end{aligned}$$

30. (New) The method of claim 3, further comprising the steps of:

using the approximation to obtain a phase rotation value for a first input sample of k=1, wherein $\sin(2\pi\hat{e})$ and $\cos(2\pi\hat{e})$ are series-expanded to minimize the approximation error;

using a phase rotation value for a previous input sample including k=1 to obtain a phase rotation value for a subsequent input sample; and

compensating the phase rotation values for all input samples.

31. (New) The method of claim 30, wherein an estimated carrier frequency effect $\hat{e}$ is represented by $\hat{\varepsilon} = \frac{1}{2\pi}\arctan\left\{\frac{\sum_{i=1}^{L}\mathrm{Im}(y(-i)y^{*}(L-i))}{\sum_{i=1}^{L}\mathrm{Re}(y(-i)y^{*}(L-i))}\right\}$, where Re and Im represent a real part and an imaginary part, respectively, of a complex number, y(i) represents an i-th received sample, L is a fast fourier transformation (FFT) size, and $\hat{\varepsilon}$ is an estimated and normalized carrier frequency offset of $\Delta\hat{f}T$.

32. (New) The method of claim 31, wherein the phase rotation value for a k-th sample is calculated by:

$$For \quad k=1, \quad \cos(\Delta\hat{\omega}T_s) = \sum_{n=0}^{N} (-1)^n \frac{\Delta\hat{\omega}T_s^{\,2n}}{(2n)!}$$

$$\sin(\Delta\hat{\omega}T_s) = \sum_{n=0}^{N} (-1)^n \frac{\Delta\hat{\omega}T_s^{\,(2n+1)}}{(2n+1)!}$$

$$\begin{aligned} For \quad k \geq 2, \quad \cos(k\Delta\hat{\omega}T_s) &= \cos((k-1)\Delta\hat{\omega}T_s + \Delta\hat{\omega}T_s) \\ &= \cos((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s) - \sin((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s) \\ \sin(k\Delta\hat{\omega}T_s) &= \sin((k-1)\Delta\hat{\omega}T_s + \Delta\hat{\omega}T_s) \\ &= \sin((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s) + \cos((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s) \end{aligned}$$

33. (New) The method of claim 8, further comprising the steps of:

using the approximation to obtain a phase rotation value for a first input sample of k=1, wherein $\sin(2\pi\,\hat{e})$ and $\cos(2\pi\,\hat{e})$ are series-expanded to minimize the approximation error;

using a phase rotation value for a previous input sample including k=1 to obtain a phase rotation value for a subsequent input sample; and

compensating the phase rotation values for all input samples.

34. (New) The method of claim 33, wherein an estimated carrier frequency effect $\hat{e}$ is

represented by $\hat{\varepsilon} = \frac{1}{2\pi}\arctan\left\{\frac{\sum_{i=1}^{L}\mathrm{Im}(y(-i)y^{*}(L-i))}{\sum_{i=1}^{L}\mathrm{Re}(y(-i)y^{*}(L-i))}\right\}$, where Re and Im represent a real part and an imaginary part, respectively, of a complex number, y(i) represents an i-th received sample, L is a fast fourier transformation (FFT) size, and $\hat{\varepsilon}$ is an estimated and normalized carrier frequency offset of $\Delta\hat{f}T$.

35. (New) The method of claim 34, wherein the phase rotation value for a k-th sample is calculated by:

$$For\quad k=1,\quad \cos(\Delta\hat{\omega}T_s) = \sum_{n=0}^{N}(-1)^n \frac{\Delta\hat{\omega}T_s^{\,2n}}{(2n)!}$$

$$\sin(\Delta\hat{\omega}T_s) = \sum_{n=0}^{N}(-1)^n \frac{\Delta\hat{\omega}T_s^{\,(2n+1)}}{(2n+1)!}$$

$$\begin{aligned} For\quad k\geq 2,\quad \cos(k\Delta\hat{\omega}T_s) &= \cos((k-1)\Delta\hat{\omega}T_s + \Delta\hat{\omega}T_s) \\ &= \cos((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s) - \sin((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s) \\ \sin(k\Delta\hat{\omega}T_s) &= \sin((k-1)\Delta\hat{\omega}T_s + \Delta\hat{\omega}T_s) \\ &= \sin((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s) + \cos((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s) \end{aligned}$$

36. (New) The system of claim 14, wherein the operational processing unit uses the approximation to obtain a phase rotation value for a first input sample of k=1, wherein $\sin(2\pi \hat{e})$ and $\cos(2\pi \hat{e})$ are series-expanded to minimize the approximation error;

using a phase rotation value for a previous input sample including k=1 to obtain a phase rotation value for a subsequent input sample; and

compensating the phase rotation values for all input samples.

37. (New) The system of claim 36, wherein an estimated carrier frequency effect $\hat{e}$ is represented by $\hat{\varepsilon} = \frac{1}{2\pi}\arctan\left\{\frac{\sum_{i=1}^{L} \mathrm{Im}(y(-i)y^{*}(L-i))}{\sum_{i=1}^{L} \mathrm{Re}(y(-i)y^{*}(L-i))}\right\}$, where Re and Im represent a real part and an imaginary part, respectively, of a complex number, y(i) represents an i-th received sample, L is a fast fourier transformation (FFT) size, and $\hat{\varepsilon}$ is an estimated and normalized carrier frequency offset of $\Delta\hat{f}T$.

38. (New) The system of claim 37, wherein the phase rotation value for a k-th sample is calculated by:

$$For \quad k=1, \quad \cos(\Delta\hat{\omega}T_s)=\sum_{n=0}^{N}(-1)^n\frac{\Delta\hat{\omega}T_s^{\,2n}}{(2n)!}$$

$$\sin(\Delta\hat{\omega}T_s)=\sum_{n=0}^{N}(-1)^n\frac{\Delta\hat{\omega}T_s^{\,(2n+1)}}{(2n+1)!}$$

$$\begin{aligned}For \quad k\geq 2, \quad \cos(k\Delta\hat{\omega}T_s)&=\cos((k-1)\Delta\hat{\omega}T_s+\Delta\hat{\omega}T_s)\\&=\cos((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s)-\sin((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s)\\\sin(k\Delta\hat{\omega}T_s)&=\sin((k-1)\Delta\hat{\omega}T_s+\Delta\hat{\omega}T_s)\\&=\sin((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s)+\cos((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s)\end{aligned}$$

39. (New) The system of claim 17, further comprising the steps of:.

using the approximation to obtain a phase rotation value for a first input sample of k=1, wherein $\sin(2\pi\,\hat{e})$ and $\cos(2\pi\,\hat{e})$ are series-expanded to minimize the approximation error;

using a phase rotation value for a previous input sample including k=1 to obtain a phase rotation value for a subsequent input sample; and

compensating the phase rotation values for all input samples.

40. (New) The system of claim 39, wherein an estimated carrier frequency effect $\hat{e}$ is represented by $\hat{\varepsilon}=\dfrac{1}{2\pi}\arctan\left\{\dfrac{\sum_{i=1}^{L}\mathrm{Im}(y(-i)y^*(L-i))}{\sum_{i=1}^{L}\mathrm{Re}(y(-i)y^*(L-i))}\right\}$, where Re and Im represent a real part

and an imaginary part, respectively, of a complex number, y(i) represents an i-th received sample, L is a fast fourier transformation (FFT) size, and $\hat{\varepsilon}$ is an estimated and normalized carrier frequency offset of $\Delta\hat{f}T$.

41. (New) The system of claim 40, wherein the phase rotation value for a k-th sample is calculated by:

$$For \quad k=1, \quad \cos(\Delta\hat{\omega}T_s) = \sum_{n=0}^{N} (-1)^n \frac{\Delta\hat{\omega}T_s^{\,2n}}{(2n)!}$$

$$\sin(\Delta\hat{\omega}T_s) = \sum_{n=0}^{N} (-1)^n \frac{\Delta\hat{\omega}T_s^{\,(2n+1)}}{(2n+1)!}$$

$$\begin{aligned} For \quad k \geq 2, \quad \cos(k\Delta\hat{\omega}T_s) &= \cos((k-1)\Delta\hat{\omega}T_s + \Delta\hat{\omega}T_s) \\ &= \cos((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s) - \sin((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s) \\ \sin(k\Delta\hat{\omega}T_s) &= \sin((k-1)\Delta\hat{\omega}T_s + \Delta\hat{\omega}T_s) \\ &= \sin((k-1)\Delta\hat{\omega}T_s)\cos(\Delta\hat{\omega}T_s) + \cos((k-1)\Delta\hat{\omega}T_s)\sin(\Delta\hat{\omega}T_s) \end{aligned}$$